

S/N: 10/ 761,613
Docket : CS03-050
Reply to the Office Action dated 10/04/2005

Page 5

1

2

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listing, of claims in the application:

6

Listing of claims:

8

9

1. (CURRENTLY AMENDED) A method of forming a semiconductor device comprising:

a) forming a gate structure over a substrate being doped with a first conductivity type impurity;

b) performing a doped depletion region implantation by implanting ions being the a second conductive type to into the substrate to form doped depletion regions; ~~beneath and separated from said source/drain regions;~~

c) performing a S/D ~~implantation~~ ~~implant~~ by implanting ions having a the second conductivity type into the substrate to form S/D source and drain regions adjacent to said gate structure; the doped depletion regions are beneath and separated from said source and drain regions;

(1) said doped depletion regions ~~have~~ having an impurity concentration and thickness so that said doped depletion regions are depleted due to a built-in potential created between said doped depletion regions and said substrate.

24

2. (CURRENTLY AMENDED) The method of claim 1 wherein said doped depletion region regions are not formed under said gate structure.

3. (CURRENTLY AMENDED) The method of claim 1 which further includes said doped depletion regions ~~have a~~ having an impurity concentration so that ~~the a~~ built-in

S/N: 10/ 761,613
Docket : CS03-050
Reply to the Office Action dated 10/04/2005

Page 6

- 1 junction potential between said doped depletion regions and said substrate forms
2 depletion regions in the substrate between the ~~source/drain~~ source and drain regions and
3 the doped depletion ~~regions~~ region;
4 said depletion regions have a net impurity concentration of the first conductivity
5 type.
6
- 7 4. (CURRENTLY AMENDED) The method of claim 1 which further includes said
8 doped depletion regions ~~have a~~ having an impurity concentration so that ~~the a~~ built-in
9 junction potential between said doped depletion regions and said substrate forms
10 depletion regions in the substrate between the ~~source/drain~~ source and drain regions and
11 the doped depletion region; said depletion regions have a net impurity concentration of
12 the first conductivity type;
13 said depletion regions have a net impurity concentration between 1E16 to 5E18
14 atom/cc.
15
- 16 5. (CURRENTLY AMENDED) The method of claim 1 which further includes
17 implanting ions of ~~a the~~ the first impurity type into said substrate between said ~~source/drain~~
18 source and drain regions and said doped depletion regions.
19
- 20 6. (CURRENTLY AMENDED) The method of claim 1 which further includes
21 performing an implant type selected from the group consisting of Halo implant, threshold
22 voltage implant, and a field implant, that implant ions of ~~a the~~ the first impurity type into
23 said substrate at least between said ~~source/drain~~ source and drain regions and said doped
24 depletion regions.
25
- 26 7. (CURRENTLY AMENDED) The method of claim 1 wherein ~~the a~~ a region of said
27 substrate between said source/drain regions and said doped depletion regions has a
28 concentration of ~~a the~~ the first conductivity type impurity between 1E16 to 1E18 atom/cc;
a channel region in said substrate under said gate structure; said channel region has a
concentration of a second type impurity between 1E16 to 1E18 atom/cc.

S/N: 10/ 761,613
Docket : CS03-050
Reply to the Office Action dated 10/04/2005

Page 7

- 1
2 8. (CURRENTLY AMENDED) The method of claim 1 wherein said doped depletion
3 regions are fully depleted.
4 9. (CURRENTLY AMENDED) The method of claim 1 which further includes performing
5 LDD implantation by implanting ions being a the second conductivity type into the
6 substrate using the gate structure as a mask to form LDD regions.
7 10. (CURRENTLY AMENDED) The method of claim 1 which further includes
8 performing a LDD implantation by implanting ions being a the second conductivity type
9 into the substrate using the gate structure as a mask to form LDD regions;
10 the LDD regions are formed before the doped depletion regions.
11 11. (CURRENTLY AMENDED) The method of claim 1 which further includes
12 performing a LDD implantation by implanting ions being a the second conductivity type
13 into the substrate using the gate structure as a mask to form LDD regions;
14 wherein the doped depletion regions are formed after the LDD regions.
15 12. (CURRENTLY AMENDED) The method of claim 1 wherein said first ~~conductive~~
16 conductivity type is p-type and said substrate has a boron concentration between 1E17
17 to 1E19 atom/cc.
18 13. (CURRENTLY AMENDED) The method of claim 1 wherein said first ~~conductive~~
19 conductivity type is n-type and said substrate ~~100~~ has a an As or P concentration
20 between 1E 17 to 1E 19 atom/cc.
21 14. (CURRENTLY AMENDED) The method of claim 1 wherein said ~~first conductive~~
22 type substrate is comprised of Si or SiGe or strained Si, or relaxed SiGe or strained Ge.
23 15. (ORIGINAL) The method of claim 1 wherein said gate structure has a channel width
24 between 0.04 and 0.5 μm .
25
26 16. (CURRENTLY AMENDED) The method of claim 1 ~~wherein~~ which further includes
27 performing a LDD implantation by implanting ions being the second conductivity type
28 into the substrate using the gate structure as a mask to form LDD regions;

S/N: 10/ 761,613
Docket : CS03-050
Reply to the Office Action dated 10/04/2005

Page 8

1 the LDD implantation is performed by implanting As ions at a dose between $5E14$ and
2 $1E16$ atoms /cm², at an energy between 1keV and 10 keV.

3 17. (CURRENTLY AMENDED) The method of claim 1 ~~wherein which further includes~~
4 performing a LDD implantation by implanting ions being the second conductivity type
5 into the substrate using the gate structure as a mask to form LDD regions;

6 the LDD implantation is performed by implanting Boron ions at a dose between $1E14$
7 and $5E15$ atoms /cm², at an energy between 1 keV and 10 keV.

8
9 18. (CURRENTLY AMENDED) The method of claim 1 wherein the doped depletion
10 region implantation is performed by implanting As or P ions at a ~~does dose~~ between
11 $5E12$ and $5E13$ atoms/cm², at an energy between 100 keV and 500 keV; said doped
12 depletion region ~~has having~~ a minimum depth below ~~the substrate~~ a surface of said
13 substrate between 0.09 and 0.7 μ m.

14 19. (CURRENTLY AMENDED) The method of claim 1 wherein the doped depletion
15 region implantation is performed by implanting boron ions at a ~~does dose~~ between $5E11$
16 and $5E13$ atoms/cm², at an energy between 50 keV and 200 keV; said doped depletion
17 region ~~has having~~ a minimum depth below ~~the substrate~~ a surface of the substrate
18 between 0.09 and 0.7 μ m.

19 20. (CURRENTLY AMENDED) The method of claim 1 wherein the S/D implantation
20 ~~implant~~ is performed by implanting arsenic (As) or phosphorus (P) ions at a dose
21 between $5E14$ to $1E16$ atoms/cm², at an energy between 50 keV and 80 keV; said
22 ~~Source/drain source and drain regions have having~~ a depth below ~~the substrate~~ a surface
23 of said substrate of between 0.04 and 0.5 μ m.

24 21. (CURRENTLY AMENDED) The method of claim 1 wherein said second
25 conductivity type is p-type; and said S/D implant is performed by implanting boron ions
26 at a dose between $5E14$ to $1E16$ atoms/cm², at an energy between 50keV and 80keV; said
27 ~~source/drain source and drain regions have~~ a depth below ~~the substrate~~ a surface of said
28 substrate of between 0.04 and 0.5 μ m.

S/N: 10/ 761,613
 Docket : CS03-050
 Reply to the Office Action dated 10/04/2005

Page 9

1 22. (CURRENTLY AMENDED) The method of claim 1 which further includes said gate
 2 structure having sidewalls; and forming one or more spacers on the sidewalls of said gate
 3 structure.

4
 5 23. (CURRENTLY AMENDED) A method of forming a semiconductor device comprising:

- a) forming a gate structure over ~~on~~ a substrate being doped with a first conductivity type impurity;
- b) performing a doped depletion region implantation by implanting ions being ~~the~~ a second ~~conductive~~ conductivity type to the substrate to form doped depletion regions beneath and separated from said source/drain regions;
 - (1) said doped depletion regions have an impurity concentration and thickness so that said doped depletion regions are depleted due to a built-in potential created between said doped depletion regions and said substrate;
 - (2) ~~said doped depletion regions have a impurity concentration so that the built in junction potential between said doped depletion regions and said substrate forms depletion regions in the substrate between the source/drain regions and the doped depletion region; said depletion regions have a net impurity concentration of the first conductivity type; said depletion regions have a net impurity concentration between 1E16 to 1E18 atom/cc;~~
- c) performing a S/D ~~implantation~~ implant by implanting ions ~~having a~~ being the second conductivity type into the substrate to form ~~S/D source and drain~~ source and drain regions adjacent to said gate structure;
 - (1) said substrate between said ~~source/drain~~ source and drain regions and said doped depletion regions has a concentration of ~~a~~ the first type impurity between 1E16 to 1E18 atom/cc[.];
said doped depletion regions have an impurity concentration so that the built-in potential between said doped depletion regions and said substrate forms depletion

S/N: 10/ 761,613
Docket : CS03-050
Reply to the Office Action dated 10/04/2005

Page 10

regions in the substrate between the source and drain regions and the doped depletion region; said depletion regions have a net impurity concentration of the first conductivity type; said depletion regions have a net impurity concentration between 1E16 to 1E18 atom/cc.

24. (CURRENTLY AMENDED) The method of claim 23 wherein said doped depletion regions ~~region~~ are not formed under said gate structure.

25. (CURRENTLY AMENDED) The method of claim 23 wherein ~~the~~ a region of said substrate between said source/drain regions and said doped depletion regions has a concentration of a said first conductivity type impurity between 1E16 to 1E18 atom/cc;
a channel region in said substrate under said gate structure; said channel region has a concentration of ~~a the~~ the second conductivity type impurity between 1E16 to 1E18 atom/cc.

26.(CURRENTLY AMENDED) The method of claim 23 which further includes; said gate structure has sidewalls; forming one or more spacers on the sidewalls of said gate structure.

27. (CURRENTLY AMENDED) The method of claim 23 which further includes; said gate structure has sidewalls; forming two or more spacers on the sidewalls of said gate structure prior to the doped depletion region implantation.

CLAIMS 28 TO 35 (CANCELED)

36.(NEW) The method of claim 1 which further includes said gate structure has sidewalls; forming one or more spacers on the sidewalls of said gate structure.

37. (NEW) The method of claim 1 which further includes said gate structure has sidewalls; forming two or more spacers on the sidewalls of said gate structure prior to the doped depletion region implantation.

38. (New) A method of forming a semiconductor device comprising:

S/N: 10/ 761,613
Docket : CS03-050
Reply to the Office Action dated 10/04/2005

Page 11

forming a gate structure over a substrate being doped with a first conductivity type impurity;

performing a doped depletion region implantation by, using said gate structure as an implant mask and implanting ions being of a second conductive type into the substrate to form doped depletion regions;

performing a S/D implantation by implanting ions of the second conductivity type into the substrate to form source and drain regions adjacent to said gate;

the doped depletion regions are beneath and separated from said source and drain regions; said doped depletion regions have an impurity concentration and thickness so that said doped depletion regions are depleted due to a built-in potential created between said doped depletion regions and said substrate.

39. (New) The method of claim 38 which further includes said doped depletion regions having an impurity concentration so that a built-in junction potential between said doped depletion regions and said substrate forms depletion regions in the substrate between the source and drain regions and the doped depletion regions;

said depletion regions have a net impurity concentration of the first conductivity type.

40. (New) The method of claim 38 wherein said doped depletion regions are fully depleted.